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Applicant : JOHOJI et al.
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Examiner : Nathan Nutter
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February 6, 2004

Supplement - Submission of JIS K6251

Commissioner for Patents
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Dear Sir:

The present specification and various claims may refer to Japanese Industrial Standard ("JIS") K6251. A copy thereof is provided herewith to facilitate the Examiner's review of the application consistent with the February 4, 2004 Amendment (see page 9 thereof). It was intended that this paper be enclosed with said Amendment and any inconvenience to the Examiner is regretted. Applicants do respectfully solicit favorable action on the merits.

CERTIFICATE OF FACSIMILE: I hereby certify that these papers (Supplement - Submission of JIS K6251 and copy of JIS K6251) are being transmitted via facsimile to: Commissioner of Patents, Washington, D.C. 20231, Attn: Examiner Nathan Nutter, on this day of February 6, 2004.

Respectfully submitted,

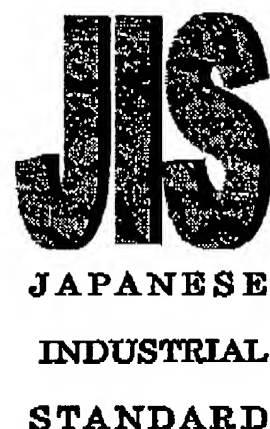
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ICS: 83.060



JIS K 6251 : 1993

**Tensile testing methods
vulcanized rubber**

Translation without guarantee
In the event of any doubt arising, the original
Standard in Japanese is to be evidence

Translated

by

Japanese Standards Association

1-24, Akasaka 4, Minato-ku Tokyo 107-8440 Japan

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JAPANESE INDUSTRIAL STANDARD

JIS K 6251:1993

Tensile testing methods for vulcanized rubber

1 Scope This Japanese Industrial Standard specifies testing methods for tensile strength, elongation at break, and tensile stress of vulcanized rubber.

Remarks 1 The standards cited in this Standard are listed as follows.

JIS B 7721 *Tensile testing machines*

JIS K 6200 *Glossary of terms used in rubber industry*

JIS K 6250 *General rules of physical testing methods for rubber, vulcanized or thermoplastic*

JIS Z 8401 *Rules for rounding off of numerical values*

2 The International Standard corresponding to this Standard is as follows.

ISO 87:1977 *Rubber, vulcanized—Determination of tensile stress-strain properties*

3 The units and numerical values given in () in this Standard are based on the traditional units, and are standard values. However, the traditional units shall become informative reference on and after April the 1st in 1995.

2 Definitions The definitions of main terms used in this Standard shall conform to those in JIS K 6200 and JIS K 6250.

3 Test apparatus

3.1 Test apparatus Principally, test apparatus shall follow JIS B 7721.

3.2 Mechanism of tester The tester is equipped with the device indicating the maximum tensile force, and in case of using a dumbbell type test piece, equipped with automatically clamping grips, and in case of ring type test piece, with the device capable of rotating the test piece while applying tensile force.

3.3 Weighing capacity of tester The weighing capacity of the tester shall be such that the maximum tensile force exerted during test falls in the range from 20 % to 100 % of the weighing capacity of the tester.

3.4 Tension speed of tester The tension speed of the tester shall be such that the traveling speed of grips for test piece conforms to the specification in 5.1 (4).

3.5 Diameter of pulley The diameter of a pulley, needed when a ring type test piece is attached, shall be as follows.

Ring type test piece No. 1 25 mm in diameter

Ring type test piece No. 2 4.5 mm in diameter

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3.6 Tolerance of tester The tolerance of scales of the tester indicating tensile force shall be $\pm 1\%$ of each indicated value.

Remarks: Employ the tester of class 1 specified in clause 7 of JIS B 7721 or superior one.

4 Test piece

4.1 Shape and dimensions of test piece The shape and dimensions of the test piece shall follow Fig. 1 and Table 1.

Remarks 1 Test pieces of No. 3 and No. 5 of dumbbell type shall be standard test pieces. No. 1 test piece is suitable for the sample with small elongation, No. 2 for the sample with small tensile strength, No. 4 for the sample of pure rubber compounded sheet, No. 6 for the sample whose width is too narrow to prepare standard sample, and No. 7 for the sample whose size is very small.

In case of a ring type test piece, No. 1 test piece is adopted as standard. No. 2 test piece is used when standard test piece cannot be taken.

2 If shape or dimensions of test pieces are different each other, the same data cannot be necessarily obtained, therefore the same type of a test piece must be employed in case of comparison test.

Unit: mm

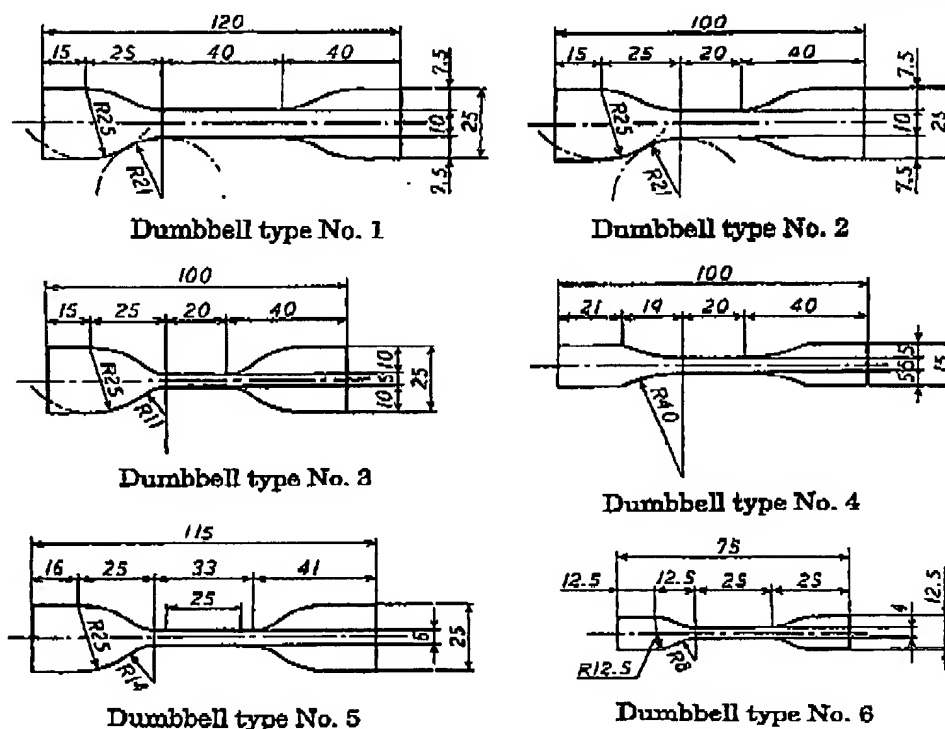
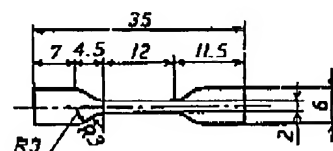


Fig. 1 Shape and dimensions of test piece

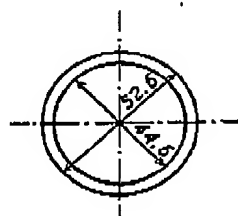
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Unit: mm



Dumbbell type No. 7



Ring type No. 1



Ring type No. 2

Fig. 1 (continued)

Table 1 Dimensions of test piece

Unit: mm

Shape	Dimensions of main parts			
	Width of parallel part	Length of parallel part	Thickness of parallel part	Distance between bench marks
Dumbbell type No. 1	10±0.1	40	2.0±0.2	40
Dumbbell type No. 2	10±0.1	20	2.0±0.2	20
Dumbbell type No. 3	5±0.1	20	2.0±0.2	20
Dumbbell type No. 4	5±0.1	20	1.0 max.	20
Dumbbell type No. 6	6 ^{+0.4} ₀	33	2.0±0.2	25
Dumbbell type No. 6	4±0.1	25	2.0±0.2	20
Dumbbell type No. 7	2±0.1	12	1.0±0.1	10

Shape	Outside diameter	Inside diameter	Width	Thickness	Inside circumference of test piece
Ring type No. 1	52.6	44.6	4.0±0.2	4.0±0.2	70
Ring type No. 2	10.0	8.0	1.0±0.1	1.0±0.1	12.6

4.2 Sampling and preparation of test piece The sampling and preparation of the test pieces shall principally follow subclause 5.5 of JIS K 6250. In case of dumbbell type, test pieces are principally sampled in parallel to the grain of rubber.

4.3 Number of test pieces The number of test pieces shall be 8 or more.

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4.4 Blanking die for test piece The test piece prepared by blanking die shall be cut by the die shaped as shown in Fig. 2 and Table 2.

In case of ring type test piece, a rotating cutter may be used.

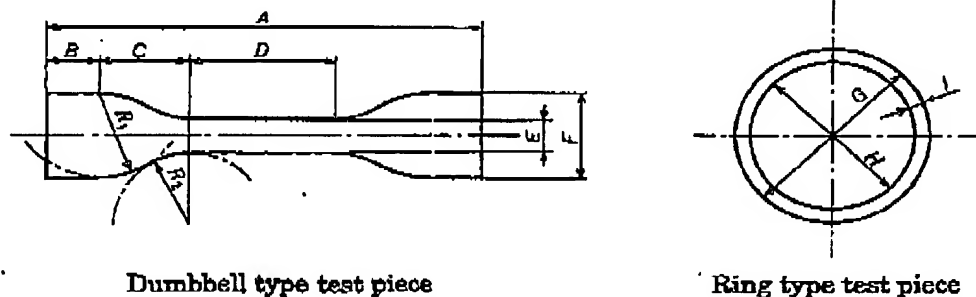


Fig. 2 Shape of blanking die for test piece

Table 2 Dimensions of blanking die for test piece

Shape	Place for dimension measurement								Unit: mm
	A	B	C	D	E	F	R ₁	R ₂	
Dumbbell type No. 1	120	15	25	40 ⁺² ₀	10.0±0.1	25.5±0.5	25.5±2.0	21 ±2.0	
Dumbbell type No. 2	100			20 ⁺² ₀					
Dumbbell type No. 3					5.0±0.1			11 ±1.0	
Dumbbell type No. 4		21	19			15.0±0.5	—	40 ±2.0	
Dumbbell type No. 5	115	16	25	33±2	6.0 ^{+0.4} ₀	25±1.0	25±2.0	14.0±1.0	
Dumbbell type No. 6	75	12.5	12.5	25±1	4.0±0.1	12.5±1.0	12.5±1.0	8.0±0.5	
Dumbbell type No. 7	35	7.0	4.5	12±0.5	2.0±0.1	6.0±0.5	(1) 3.0±0.1	3.0±0.1	

Shape	Place for dimension measurement		
	G	H	I
Ring type No. 1	52.6	44.6	4.0±0.2
Ring type No. 2	10.0	8.0	1.0±0.1

Note (1) The center of R₁ for dumbbell type No. 7 shall be located on the center line of a test piece.

Remarks 1 In case of dimension E of dumbbell type and I of ring type shown in the above table, the unevenness in width of the same die shall not exceed the limit of 0.05 mm.

2 The dimensions, which are shown in the table without tolerance, shall be regarded as standard dimensions.

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4.5 Measurement of thickness and width of test piece Before making test, measure thickness and width of the test piece. The measurement of thickness and width of the test piece shall follow subclause 5.6 of JIS K 6250.

Sectional area (A) of the test piece is calculated according to the following formulae.

For dumbbell type test piece Thickness (mm) \times width of parallel part (mm)

For ring type test piece Thickness (mm) × width (mm)

4.6 Bench marks for elongation measurement on test piece On a dumbbell type test piece, bench marks (hereafter referred to as "bench mark") for elongation measurement shall be marked as follows.

- (1) Distance between bench marks conforms to Table 1.
- (2) Bench marks shall be clearly and accurately marked on the parallel part of the test piece equidistance from the center of the test piece.

4.7 Selection of test piece Such test pieces shall not be submitted to the test as; those whose unevenness at thickness and width exceed 0.1 mm along the parallel part of dumbbell type test piece and along the whole body of ring type, and those containing alien matters, containing bubbles or having flaws.

5 Testing methods

5.1 Test condition Test conditions shall be as follows.

- (1) The standard condition of the laboratory shall follow subclause 5.1 of JIS K 6250.
- (2) The storing of sample and test pieces shall follow subclause 5.2 of JIS K 6250.
- (3) The standard condition of the test piece shall follow subclause 5.3 of JIS K 6250.
- (4) The tension speed shall be as follows.
 - (a) Dumbbell type test piece Nos. 1 to 6 500 ± 50 mm/min
Dumbbell type test piece No. 7 100 ± 10 mm/min
 - (b) Ring type test piece No. 1 300 ± 30 mm/min
Ring type test piece No. 2 100 ± 10 mm/min

Remarks : The tension speed other than the specified may be used according to the agreement between the purchaser and the supplier.

5.2 Procedures Procedures shall be as follows.

- (1) **Attaching of test piece** The test piece shall be correctly and accurately attached on the grips so as not to cause distortion of test piece, its break at the grips, or other inconvenience.

Remarks: When No. 4 test piece is used, it is advisable to apply such lubricant as talc or zinc stearate to the gripped part of the test piece.

- (2) **Measurement of tensile strength and elongation at break** The measurement of tensile strength is carried out by reading the maximum tensile force given when test piece is broken on the test apparatus shown in clause 3.

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The elongation at break is, in case of dumbbell type test piece, measured by reading the length between bench marks given when it breaks according to suitable means. In case of ring type test piece, the distance between two grips given when it breaks is measured, and obtain the value corresponding to the distance between bench marks.

- (3) **Measurement of tensile stress** In case of dumbbell type test piece, tensile stress is measured by reading tensile force given when the distance between bench marks has reached to specified value, according to suitable means.

In case of ring type test piece, read tensile force given when the distance between two grips has reached to specified value.

6 Calculation

6.1 Tensile strength Tensile strength is calculated according to the following formulae (1) and (2).

Dumbbell type test piece

$$T_B = \frac{F_B}{A} \dots \dots \dots (1)$$

Ring type test piece

$$T_B = \frac{F_B}{2A} \dots \dots \dots (2)$$

where, T_B : tensile strength (MPa) (kgf/cm²)
 F_B : maximum tensile force (N) (kgf)
 A : sectional area of test piece (mm²) (cm²)

6.2 Elongation at break The elongation at break is calculated according to the formulae (3) and (4).

Dumbbell type test piece

$$E_B = \frac{L_1 - L_0}{L_0} \times 100 \dots \dots \dots (3)$$

where, E_B : elongation at break (%)
 L_0 : distance between bench marks (mm)
 L_1 : distance between bench marks at break (mm)

Ring type test piece

$$E_B = \frac{I_1 - I_0}{I_0} \times 100 = \frac{2I + I_2 - I_0}{I_0} \times 100 \dots \dots \dots (4)$$

where, E_B : elongation at break (%)
 I : traveled distance, at break, of center point of pulley (mm)
 I_0 : initial internal circumference of test piece (mm)
 I_1 : internal circumference of test piece at break (mm)
 I_2 : circumference of pulley (mm)

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6.3 Tensile stress Tensile stress is calculated according to the following formulae (5) and (6).

Dumbbell type test piece

$$M_n = \frac{F_n}{A} \dots\dots\dots (5)$$

Ring type test piece

$$M_n = \frac{F_n}{2A} \dots\dots\dots (6)$$

where, M_n (°): tensile stress given when n % elongation is obtained (MPa) (kgf/cm²)

F_n (°): tensile force given when n % elongation is obtained (N) (kgf)

A : sectional area of test piece (mm²) (cm²)

Note (°) The symbol n in M_n and F_n means the value of n (%) for specific elongation.

For instance, M_{300} and F_{300} mean the tensile stress and tensile force shown when test piece is elongated by 300 %.

7 Rounding off of test result Carry out the tests for tensile strength, elongation at break, and tensile stress on at least 3 test pieces, round off the respective median(°) obtained by the calculation of clause 6, according to JIS Z 8401, and in case of tensile strength and tensile stress, express it with 3 significant figures and in case of elongation at break, with 2 significant figures.

Note (°) When number of measurements is odd, median is the center value when they are arranged orderly in magnitude, and when it is even, median is the average of two values that are both sides of the center.

8 Record On a test record, the following items shall be recorded.

- (1) Tensile strength, elongation at break, and tensile stress
- (2) Shape and dimensions of test piece
- (3) Sampling and preparation methods of test piece
- (4) Number of test pieces
- (5) Other necessary items

Related standards:

ASTM D 412 *Standard Test Methods for Rubber Properties in Tension*

BS 903: Part A2 *Method of testing vulcanized rubber—Determination of tensile stress-strain properties*

DIN 53504 *Determination of ultimate tensile strength, tensile strength, elongation at failure and stress values by a tensile test*

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